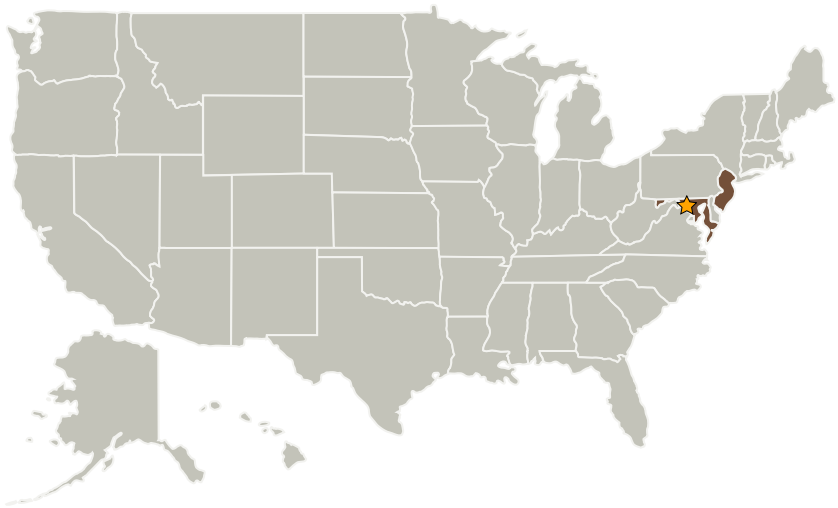
High Performance Avalanche Photodiodes for Photon Counting at 1064 nm, Phase I

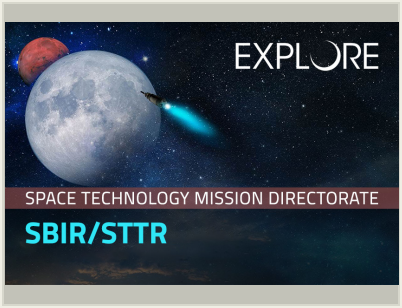
Completed Technology Project (2006 - 2006)

Project Introduction

The need for higher performance fiber optic telecommunications receivers has provided the impetus for substantial progress during the last decade in the understanding and performance of InP-based linear mode avalanche photodiodes (APDs) for the wavelength range from 1.0 to 1.7 um. However, these advances have not been paralleled in the performance and availability of single photon avalanche diodes (SPADs) based on similar design and materials platforms. Moreover, the vast majority of the activity in this field has been focused on optimizing devices for telecommunications wavelengths in the vicinity of 1550 nm, and there has been very little work on devices for use at 1064 nm. For this SBIR program, we propose to apply innovative design concepts for the development of high performance SPADs optimized for 1064 nm applications. In particular, we will implement a novel bandgap engineering approach to tailor the SPAD avalanche gain properties to realize higher single photon detection efficiency while maintaining the very low dark count rates that are made possible by optimizing the absorption region design for the detection of 1064 nm photons. We will also apply design concepts that we have innovated during the course of developing state-of-the-art 1550 nm SPADs that involve optimization of the device electric profile for photon counting as well as epitaxial layer compositions. These efforts will culminate in 1064 nm large area detectors (with active area diameters up to 500 um) that demonstrate feasibility in meeting SPAD performance targets including 50% detection efficiency, bandwidth of 500 MHz, saturation levels of 50 Mcounts/s, and non-gated operation.

Primary U.S. Work Locations and Key Partners





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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland
Princeton Lightwave, Inc.	Supporting Organization	Industry	Cranbury, New Jersey

Primary U.S. Work Locations	
Maryland	New Jersey

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Technology Areas

Primary:

- TX05 Communications, Navigation, and Orbital Debris Tracking and Characterization Systems
  - TX05.5 Revolutionary Communications Technologies
    - TX05.5.2 Quantum Communications